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SCIENTIFIC PAPER

COST ANALYSIS OF PIG SLAUGHTERING: A HUNGARIAN CASE STUDY

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Abstract: *The scale of Hungarian slaughterhouses is small in international comparison and the cost of slaughter and cutting a pig of average live weight is relatively high at 16.1-19.4 EUR on average. The aim of this study is to evaluate the cost of pig slaughter and cutting through the case study of a medium-scale plant in Hungary. Based on data from the enterprise, a calculation was performed in relation to the "output" quantity of pig slaughter and cutting, as well as its value and the cost and cost structure of processing. The capacity of the examined plant and its utilisation were analysed and cost reductions were estimated for various increases of output. In 2015, the direct cost of slaughter and cutting was 18.9 EUR per pig for the medium-scale plant which processed 100 thousand pigs. When the purchase cost of pigs is excluded, labour costs accounted for the highest share (30%) of costs, followed by services (29%) and energy costs (21%). For this reason, the level of wages and employer's contributions has a rather high significance. Analysis showed that significant increases in Hungarian minimum wage and guaranteed living wage in 2017 resulted in an estimated 7% increase in the cost of slaughter and cutting compared to 2015, despite the decrease of contributions. The capacity utilisation of the plant was a low 28% when compared to a single 8-hour shift considered full capacity. The cost of slaughter and cutting was estimated to be reduced to 14.2-17.0 EUR per pig if the plant operated at full capacity. This may be considered a lower bound estimate of cost because there are numerous restricting factors on optimising capacity utilisation, such as: 1) number of live animals available for purchase and related logistics; 2) cooling capacity availability; 3) labour availability; 4) market position of the enterprise and potential for marketing additional pig meat products. Enterprises of this scale are recommended to consider producing more value-added products and, accordingly, investing in product development.*

Keywords: *meat industry, slaughterhouse, capacity utilisation, economies of scale, slaughtering costs*
(JEL Classification: *Q13, Q19*)

INTRODUCTION

The world's population doubled during the last 50 years, while the meat production of the world increased more than fourfold. Poultry meat production increased the most, followed by pork and beef (Kozák, 2015). According to the predictions of OECD-FAO (2017), a further increase in population is expected, potentially reaching 10 billion people by 2060. It is the task of the near future to provide the world's population with proper quality food with high nutrient content that is important for maintaining a healthy life. On a worldwide scale, foods of animal origin represent an increasingly high proportion of total food; therefore, animal husbandry and the connected processing industry have a significant role in feeding the world (Horn and Sütő, 2014). Based on the related predictions, the meat production of the world is expected to increase by 32 million tons in the upcoming decade.

The aim of this study is to evaluate the cost of pig slaughter and cutting through the case study of a medium-scale plant in Hungary. This paper is looking for answers to the following questions: 1) What is the "output" amount and value during pig slaughter and cutting? 2) How much is the direct cost of processing in the case of a medium-scale slaughterhouse and which are the main cost items? 3) How does capacity utilisation affect the costs of slaughter and cutting? 4) What impact does the change of minimum wage[1], guaranteed living wage[2] and employer's contributions in Hungary in 2017 have on slaughter and cutting costs? Accordingly, two hypotheses were formulated. H1) At the plant, based on the current level of capacity utilisation, the direct cost of slaughter and cutting was between 16.1-19.4 EUR per pig in the examined period, the largest share of which was represented by labour costs. H2) The current level of capacity utilisation is low and its improvement could potentially result in reducing the cost of slaughter and cutting to even 12.9 EUR per pig.

Pig production and processing background

Poultry meat production nearly doubled in the last two decades, while the amount of pork production increased by a much lesser extent of 51%. As a result, the amount of poultry meat produced in the world in 2016 (116.8 million tons) exceeded the amount of pork produced in the same year (116.4 million tons), but the proportion of poultry and pork

1 minimum wage: for workers employed in non-qualified jobs
2 guaranteed living wage: for workers employed in jobs require at least intermediate skills

produced was different in the various examined countries and regions. In 2016, the EU28 produced 65% more pork (23.6 million tons) than poultry (14.3 million tons) and this proportion is not expected to significantly change in the upcoming decade either (FAO, 2017; OECD-FAO, 2017).

The amount of pork produced in the world is expected to increase to around 128 million tons by 2026 (FAO, 2017, OECD-FAO, 2017). In 2014, around half of the produced amount of pork originated from China, which increased its output by 84% since 1994 and it has been the main pork producer of the world for years. The US (9%), Germany (4.8%) and Spain (3.1%) are also considered to be significant producers. The ten biggest pork producers of the world provide around 78% of the total produced amount. The pork production of the EU28 increased to a smaller extent from 20.6 million tons to 22.6 million tons (+10%) over the same period and provided 20% of the pork produced in the world in 2014. In the EU, France, Poland, Denmark and the Netherlands produced significant amounts of pork in addition to Germany and Spain (FAO, 2017).

Pig slaughtering in the EU decreased by 10% between 2006 and 2012, but it has been constantly increasing since 2012, reaching 257 million pigs in 2016. The following distribution of slaughtered pigs was observed in accordance with the SEUROP[3] classification in 2016 (EU average): 57% S, 34% E, 7% U and 2% R (EC, 2017).

In Hungary, pig farming and pork production have always been of great significance. In the 1980s, the pig population consisted of 10 million pigs, but it decreased to 6 million in 1991 following the economic and political restructuring. The downfall of the sector continued after the turn of the millennium. As a result, the pig population dropped to less than 3 million by the end of 2016, leading to a significant reduction of the amount of slaughter pigs from nearly 800 thousand tons to 587 thousand tons between 2000 and 2015 (HCSO, 2017). In parallel with decreasing pig population, the number of farms with pigs had a greater reduction, in particular small farms and a concentration process can be witnessed which is favourable from the aspect of economies of scale. At the same time, the significant decrease of pork purchase prices in recent years caused severe problems for producers (Béládi et al., 2017; Jankuné Kürthy, 2017). Popp et al. (2015) consider the unorganised product path, the lack of integration, the strong presence of underground economy, low efficiency, the prevailing low technological level, the non-competitive genetic background, the lack of connection with food retail trade, the low level of qualification and research and development, the relatively high volatility of feed prices, the high indebtedness and non-creditworthiness of enterprises, the uncertainty of the land market and the lack of consumer consciousness to be among the critical factors limiting pig farming. Also, the pig slaughter in Hungarian slaughterhouses is generally of lower quality than the EU average with a SEUROP classification for Hungary of 32% S, 52% E, 10% U, and 1.2% in R/O/P classes (NFCSO, 2017).

The fluctuation of the number of pig slaughters in slaughterhouses is smaller than the fluctuation of the pig population and the reduction of the population cannot be traced in the number of slaughters. While 4.28 million pigs were slaughtered in Hungary in 2004, the increase to 4.68 million in 2016 (Bábáné Demeter, 2017) may be attributed to pig imports. Hungarian slaughterhouses used to process pigs produced in Hungary only, but the Hungarian meat industry has made up for the shortage in Hungarian pig production following the EU accession from import sources. However, these imports have contributed to the increase of costs especially due to the exchange rate that became unfavourable in 2009 (Udovecz and Nyárs 2009; FM 2015). Hungary has a slaughter capacity of processing around 8 million pigs in 2017, but the number of pigs slaughtered in Hungary following the EU accession is only around 4-4.5 million pigs. Due to the existing spare capacities, the Hungarian meat industry has low efficiency (FM 2015, Bene et al. 2016). According to Gila (2017), the average cost of slaughter and cutting in 2017 is between 16.1-19.4 EUR per pig in Hungarian slaughterhouses, considering average live weight. This cost is rather high in international comparison.

Average cost (AC) has two components: average variable cost (AVC) and average fixed cost (AFC). The utilisation of production capacities is an important component of competitive production, because AFC decreases with an increase of capacity utilisation, while AVC does not depend on the utilisation of production capacities in the case of such production scales. Accordingly, one of the most efficient ways of reducing average cost (AC), ceteris paribus, is to improve capacity utilisation in Hungarian slaughterhouses.

Some of the Hungarian plants which slaughter and cut pigs also produce meat products. In the case of enterprises performing both activities, 70-80% of their revenue originate from the production of meat products and only 20-30% originate from selling cuts. A concentration can be observed in the sector, but there are signs of specialisation: slaughter and cutting and the production of meat products are becoming increasingly separate from each other (Udovecz and Nyárs, 2009; FM, 2015).

According to the currently prevailing international tendencies, medium enterprises may disappear from the market by 2025 and the current actors need to decide whether to develop their plants in order to reach larger scale or to conform to the needs of niche markets by shifting to the production of special meat products (Mulder, 2015). The reason for this phenomenon is that enterprises which choose their strategy inappropriately and are unable to adapt to the changing environment may easily become the targets of large enterprises. Medium-sized processors lose their efficiency and competitiveness on the market due to their scale (Mulder, 2015). In the opinion of the authors of this paper, this scenario is too pessimistic, even though the tendency of medium-sized plants facing decreasing competitiveness is real. However, it

3 Pig carcases are graded according to their estimated lean-meat content: S: 60% or more; E: 55-59%; U: 50-54%; R: 45-49%; O: 40-44%; P: less than 40% (Council Regulation (EEC) No 3220/84).

is unlikely that these enterprises would disappear by 2025. The only way to increase competitiveness in the market of mass products is to reduce average cost, the most obvious method of which is to increase scale, improve efficiency and optimise the utilisation of existing capacities (Vernooij, 2015).

On a worldwide scale, it can be concluded that meat production can be considered a concentrated and specialised sector which calls for proper expertise and raw material, the latter of which is especially true in the case of meat processing as economies of scale and efficiency represent competitive advantage. In the early 1990s, a powerful development of the meat industry started in China, when large enterprises imported modern production lines, special processing procedures and complete technologies. On a world scale, giant companies which have the biggest capacity mostly use technology suitable for processing various types of meat, not just one. These enterprises operate by achieving both efficiency and economies of scale. JBS, the world's largest meat industry company is operated on the basis of similar principles, performing the primary and further processing of beef, pork, poultry and mutton. Based on its processing capacity, the company is capable of slaughtering 100 thousand cattle, 70 thousand pigs, 12 million chickens and 25 thousand sheep per day (Zhou et al., 2012; Belk et al., 2014; Bene et al., 2016).

Currently, the biggest Hungarian slaughterhouse is capable of slaughtering around 1 million pigs per year, which can be regarded medium scale in comparison with the capacity of enterprises that are significant on a world scale (MCS Vágóhíd Zrt., 2017; Hungary Meat Kft., 2017). Therefore, economies of scale is also a problem that the Hungarian meat industry has to face. In the case of larger scale, slaughter and cutting can be performed at lower costs, which makes the products leaving the processing plants more competitive.

Based on these presented factors and the thoughts of Popp et al. (2015) and FM (2015), it can be concluded that the Hungarian pig sector and meat industry are currently in a difficult situation and Hungary is not competitive on an international scale with regard to the price of the produced products (basically mass products) due to the efficiency problems appearing along the product chain (breeding, fattening, processing).

Main phases of the slaughter and cutting technology

The food safety chain of the meat industry ranges from "farm to fork" and it involves feed production, primary meat production, animal transport, slaughter and processing, selling, the related logistics services and consumption (Deák et al., 2006). This study only focuses on primary meat processing, while presenting its technological steps. The fundamental "raw material" of primary meat processing is the live animal itself, i.e., pig in this case (Jankóné, 2006). In regards to pig slaughter and processing, it is necessary to use the following classification of partial processes: 0) preparation of slaughter; 1) pig slaughter; 2) preparation (for boning); 3) boning, cutting open and removal of intestines, cutting; 4) production of end product; and 5) fat processing and packing (Sutus, 2013). The preparatory phase of slaughter involves the cleaning of the pig and veterinary duties. Stress pigs endure during transport may result in mortality. In order to avoid this problem, transport is followed by a resting period, during which animals are subjected to veterinary examination, which is the prerequirement of issuing a slaughter permit (Biró, 2014; Dikeman and Devine, 2014). The first step of the actual processing procedure is stunning, the aim of which is to reach an unconscious state. The next step is stabbing. At this stage, the objective is to extract as much blood as possible (Anonymus, 2001; Diószpatonyi, 2016). Stunned pigs are hanged upside down by their hind legs on a conveyor line which takes them along the cutting line; thereby providing easier access for veterinarians and butchers who perform processing (Anonymus, 2001). As a next step, pigs are taken to the scalding tunnel, where they are sprinkled with 64°C hot water spray. The proper cleaning of the animal starts with washing down its entire body surface using a closed body washing equipment which loosens up the follicles, thereby making it possible to (manually or mechanically) remove body hair without damaging the skin (Diószpatonyi, 2016). Dehairing is usually performed mechanically, while plucking is done manually, using a scraper (Hinrichsen, 2010). As a next step, hair and bristle remains are burnt in the singeing furnace. Flaming is done using 600-800°C gas flame, while singeing is performed with 1000-1200°C gas flame. The aim of this operation is to burn the fluffs and sterilise the body surface. The next step is the final cleaning, during which the burnt fluffs and epithelial cells are removed and the whole skin surface is cleaned. The head and limbs – which are difficult to clean – are also cleaned in this step, deformed hooves and ear fungus are removed and hooves are cut out (Madsen et al., 2006; Jankóné, 2006). Following the final cleaning, the actual processing is performed, during which the by-products are removed from the main product of slaughter. The first operation of cutting open the carcass is to remove and tie the large intestine. The next step is to cut through the sternum and open the rib cage. Then, the abdominal cavity is opened and the internal organs, such as the ventricular and intestinal tract, the tongue, lungs and heart are removed. During this process, the spleen and kidneys are also removed and the intestinal ligaments are cut, so that the pluck can be removed from the abdominal cavity. After the removal of offal, the spinal column is split in two either manually or mechanically to obtain what is called a half pig share. (Madsen et al., 2006; Jankóné, 2006; Diószpatonyi, 2016). Processing in the slaughterhouse also includes the total or partial trimming of fat. If the meat is placed on the market as unprocessed meat, the fat is trimmed entirely, but if ham and chuck are produced, the fat is not trimmed. The final steps are weighing, classification and cooling (Diószpatonyi, 2016).

MATERIALS AND METHODS

The research objective was achieved using primary data collection involving a medium-scale Hungarian enterprise

performing pig slaughter and processing. The production and technological data referring to slaughter and cutting (production process, used resources – mechanical resources, labour and purchased stocks – and their quantity, amount of slaughtered pigs, average weight at the time of slaughter, yearly stock value expressed in kg, etc.), as well as economic data (purchase prices of live pig, detailed general ledger cost data) were collected. In addition, the data and information of the annual reports of the examined enterprise between 2012 and 2016 were used. Financial data were collected and processed in HUF and were converted into EUR using the 2015 mean HUF/EUR exchange rate of 309.9. This paper relies on the primary data and information collected and related calculations regarding the work operations and costs of only the modelled plant, i.e., the slaughter and cutting plant that is the focus of this study.

Based on the technological process of pig slaughter and cutting and the 2015 stock data of the enterprise expressed in kg, the output values of processing were derived for one pig and, accordingly, the stock value of the raw material. In order to determine the latter value, the basis of calculation was selected to be the average purchase price in 2015 and the values of various by-products were also taken into consideration.

In order to determine the cost of slaughter and cutting, a post calculation structure was used on the basis of the general ledger cost items of 2015. Direct production costs represent the cost items directly related to the production process at the plant during the implementation of each work operation. This category encompasses simple direct costs which can be charged to the given cost bearer by means of direct assignment, as well as the divided costs which can be charged to the given cost bearer by means of assignment on an activity or casual basis, using a certain division basis. Overhead costs of the plant and the enterprise were not taken into consideration during calculation. Costs arising in the plant were available to us only at the plant level, as the enterprise does not separate them in accordance with the different phases of processing. Specific costs (values referring to a slaughter pig, 100 kg live weight and 100 kg carcase weight) were calculated from the direct costs of the plant. In order to evaluate the cost of slaughter and cutting, cost calculation was performed without the value of live animals, i.e., the cost of the most significant raw material.

In order to examine the impact of increasing capacity utilisation on costs by means of increasing output, it was necessary to separate fixed costs and variable costs. Based on the data in the income statements of the enterprise between 2012-2016, the response rate [1] of all costs of the enterprise was determined which expresses the proportion of variable costs compared to the total costs of the enterprise [2] (Maczó and Horváth, 2001; Kresalek, 2003).

$$\text{Cost response rate} = \frac{\text{Extent of cost change (\%)}}{\text{Extent of cost characteristic change (\%)}} \quad [1]$$

$$\text{Proportion of variable costs (\%)} = \text{Cost response rate} \times 100 \quad [2]$$

Production value was used as a cost characteristic and the values of the four examined years (2012-2013, 2013-2014, 2014-2015 and 2015-2016) were averaged. As a next step, the relative proportions of fixed and variable costs were determined at enterprise-level without the cost of live animals – which is typically a variable cost. These rates were used at the plant level also, presuming similar proportions of variable and fixed costs. Therefore, these assumed values are the estimated proportions of fixed and variable costs at the plant level. These proportions are assumed to be constant as the level of production increase. Furthermore, a sensitivity analysis was done based on expert opinion of possible alternative values for the proportions of fixed and variable costs. Accordingly, calculations were performed both with lower and higher rate of variable costs in comparison with the assumed value. Consequently, slaughter and cutting costs demonstrated in correlation with increasing the output were calculated with different response rates.

In Hungary, minimum wage and guaranteed living wage significantly increased in 2016 and 2017 and the amount of contribution to be paid by the employer greatly decreased in 2017. The impact of the change of wage level and contributions on slaughter and cutting costs (ceteris paribus) was examined in 2016 and 2017, compared to 2015.

RESULTS AND DISCUSSION

The annual revenue of the examined enterprise was between 16.2 and 20.7 million EUR during 2012-2016, with the average value being 18.5 million EUR. On average, nearly 95% of revenue originated from domestic sales and 5% of it was from exports. 96-97% of the revenue from domestic sales represents the revenue from stocks produced by the enterprise, i.e., fresh and chilled half pig shares, pork cuts, pluck, other by-products and meat products. A significant part of this share is sold by retail chains. The enterprise also operates its own shop where they directly sell their own and purchased products. The trade realised in this shop contributes 2-3% to the revenue of domestic sales. In addition, the enterprise also performs hired work of slaughtering and boning pigs, representing 0.5-1% of its domestic turnover. The export sales of the enterprise are mostly directed toward other EU Member States (Germany, Romania, Poland, Slovakia), and includes selling unprocessed pig intestines, bacon and fat to Slovakia, fat and trimmings to Poland and tenderloin to Romania.

Around 100 thousand pigs are slaughtered per year in the examined medium-scale Hungarian plant, which equals around 400 pigs per day if one calculates with 250 workdays per year on average. Pigs are slaughtered every second day for 4.5 hours per day in the plant and the remaining working hours are spent with cutting, boning and producing casings. The maximum hourly capacity of the plant is slaughtering 200 pigs, but the actually realised throughput capacity is 180. This value lags behind the larger Western European processing plants which usually apply more modern technology. The usual capacity is 200-400 slaughtered pigs per hour in Western Europe, while this number is 1000 in the US (WATTAgNet, 2008).

Table 1. Output and raw material stock value against the level of processing

Phase	No.	Description	Quantity (kg per pig)	Proportion (%)	Proportion (%)	Value (EUR per pig)	Value (EUR per 100 kg)
I.	1.	Live weight	111.00	100.00	-	126.17	113.66
	2.	By-products (offal)	4.17	3.76	-	1.90	45.52
	3.	Waste	17.17	15.47	-	-	-
	4.	Qualified pig with fat (warm carcase) (1-2-3)	89.66	80.77	100.00	124.27	138.60
	5.	Flare fat	1.91	1.72	2.13	0.62	32.27
	6.	Half pig share with fat, feet and head (warm carcase) (4-5)	87.75	79.05	97.87	123.65	140.92
	7.	Cooling loss	0.45	0.40	0.50	-	-
	8.	Half pig share with fat, feet and head (warm carcase) (6-7)	87.30	78.65	97.37	123.65	141.64
	9.	Head, ears	1.61	1.45	1.80	0.50	30.78
	10.	Half pig share with fat, without the head (warm carcase) (6-9)	86.14	77.60	96.07	123.16	142.97
	11.	Cooling loss	0.45	0.40	0.50	-	-
	12.	Half pig share with fat, without the head (cold carcase) (10-11)	85.69	77.20	95.57	123.16	143.72
II.	13.	Half pig share with fat, without the head (cold carcase)	85.69	77.20	100.00	123.16	143.72
	14.	Fat	23.11	20.82	26.97	11.22	48.53
	15.	Half pig share without fat and head (cold carcase) (13-14)	62.58	56.38	73.03	111.94	178.88
III.	16.	Half pig share without fat and head (cold carcase)	62.58	56.38	100.00	111.94	178.88
	17.	By-products (bone, cartilages, joints, etc.)	8.76	7.89	14.00	3.97	45.26
	18.	Chopped and boned meats total (16-17)	53.82	48.49	86.00	107.98	200.63

Source: own calculation based on enterprise data collection

Based on the operational data of the enterprise, the live weight of pigs is 111 kg at the time of slaughter, which is approximately the same as the relevant international data (Rasmussen 2006). The scale of the examined enterprise calls for the use of direct manual labour of around 100 people, 60% of whom are skilled and 40% are unskilled labourers. The high proportion of the latter is explained by the fact that the work procedures of processing, which do not call for any qualifications, can also be performed by unskilled labourers.

Three phases of processing are performed in the plant, while meat products are produced in a separate plant unit. As mentioned above, this study focuses on the work operations and costs of only the slaughter and cutting plant. By following the main work processes (Table 1), it can be concluded that, based on the processing of slaughter pigs of 111 kg live weight (100%), meat output can be derived as follows: 89.66 kg (80.77%) qualified pig with fat (warm carcase weight), 87.3 kg (78.65%) cold half pig share with fat, 85.69 kg (77.20%) cold half pig share with fat without the head, 62.58 kg (56.38%) cold half pig share without fat and head and 53.82 kg (48.49%) chopped and boned meat. The purchase price of live pig was between 110-123 EUR per 100 kg between 2012 and 2016, with the average being 113.7 EUR per 100 kg in 2015. Based on the examined production process, the stock value of raw material – which amounts to a significant proportion of average costs – is 141.6 EUR per 100 kg of cold half pig share with fat, 143.7 EUR per 100 kg of cold half pig share with fat without the head, 178.9 EUR per 100 kg of cold half pig share without fat and head and 200.6 EUR per 100 kg of chopped and boned meat products.

Of the 100 thousand pigs slaughtered in the plant, 30% (2 619 tons) is sold by the enterprise as cold half pig share with fat. 17% of the meat to be further processed is sold as cold half pig share without fat (751 tons), which is 12% of all slaughtered live animals. 58% of slaughtered animals (3 122 tons) is sold as chopped and boned meat products and a small proportion is used for producing various meat products within the enterprise. The presented cost relations are to be interpreted along this product structure and the related processing structure.

The total direct production cost of processing 100 thousand slaughter pigs was 14.5 million EUR, nearly 87% of which represented the cost of live animals (12.6 million EUR). The direct production cost arising during processing – without the cost of live animals – was 1.9 million EUR per year. In the plant, the slaughter and cutting cost of a pig was 18.90 EUR in 2015, which, projected to live weight, was 17.02 EUR per 100 kg, while it was 21.54 EUR per 100 kg of carcase weight (Table 2). If only the cost directly related to slaughter and cutting is taken into consideration, it can be concluded that labour cost is the largest cost item (30%), despite the fact that manual labour is employed at the prevailing minimum wage and the guaranteed living wage. Used services (29%) and energy costs (21%) also represent significant shares. Of the used services, trade and marketing fees/expenses amounted to nearly 200 thousand EUR in the given year. The enterprise pays these fees/expenses to retail chains on various legal grounds. These costs amounted to 1-1.5% of the revenue of 2015. Other costs include depreciation (7%), indirect material (6%) and packaging material (4%).

Under the current circumstances in terms of output level (slaughter and cutting of 100 thousand slaughter pigs per year)

Table 2. Slaughter and cutting costs of the plant (2015)

No.	Description	Plant value[1] (EUR)	Value per pig (EUR/pig)	Value per live weight[2] (EUR/100kg)	Value per carcase weight[3] (EUR/100kg)	Distribution[4] (%)
1.	Live animals	12 616 798	126.17	113.66	143.79	-
2.	Packing material	74 895	0.75	0.67	0.85	4.0
3.	Raw material – total (Σ 1-2)	12 691 693	126.92	114.34	144.64	4.0
4.	Cleaning products	16 763	0.17	0.15	0.19	0.9
5.	Maintenance material	75 353	0.75	0.68	0.86	4.0
6.	Working and protective clothes	11 884	0.12	0.11	0.14	0.6
7.	Material used in production	13 198	0.13	0.12	0.15	0.7
8.	Other material	4 298	0.04	0.04	0.05	0.2
9.	Indirect material – total (Σ 4-8)	121 497	1.21	1.09	1.38	6.4
10.	Electric energy	118 038	1.18	1.06	1.35	6.2
11.	Gas	77 809	0.78	0.70	0.89	4.1
12.	Water	11 381	0.11	0.10	0.13	0.6
13.	Fuel for vehicles	189 058	1.89	1.70	2.15	10.0
14.	Energy – total (Σ 10-13)	396 286	3.96	3.57	4.52	21.0
15.	Trade and marketing costs	198 545	1.99	1.79	2.26	10.5
16.	Working clothes handling costs	48 403	0.48	0.44	0.55	2.6
17.	Cold store, freezing	57 115	0.57	0.51	0.65	3.0
18.	Meat inspection	54 743	0.55	0.49	0.62	2.9
19.	Cost of hazardous waste	47 002	0.47	0.42	0.54	2.5
20.	Maintenance costs	36 037	0.36	0.32	0.41	1.9
21.	Live animal qualification	20 123	0.20	0.18	0.23	1.1
22.	Laboratory analyses	7 348	0.07	0.07	0.08	0.4
23.	Transport and loading costs	49 264	0.49	0.44	0.56	2.6
24.	Other used services	34 095	0.34	0.31	0.39	1.8
25.	Used services – total (Σ 15-24)	552 675	5.53	4.98	6.67	29.2
26.	Other services	32 369	0.32	0.29	0.37	1.7
27.	Material costs – total (3+9+14+25+26)	13 794 520	137.95	124.27	157.21	62.3
28.	Wages	446 079	4.46	4.02	5.08	23.6
29.	Employer's contributions	127 133	1.27	1.15	1.45	6.7
30.	Labour costs (Σ 28-29)	573 212	5.73	5.16	6.53	30.3
31.	Depreciation	138 754	1.39	1.25	1.58	7.3
32.	Direct costs – total (27+30+31)	14 506 487	145.06	130.69	165.32	-
33.	Direct costs excluding live animals (32-1)	1 889 688	18.90	17.02	21.54	100.0

[1]Based on the processing of 100 thousand slaughter pigs • [2]Slaughter weight: 111 kg per pig
[3]Value in the case of 111 kg slaughter weight: 89.66 kg per pig • [4]Excluding live animals
Source: own calculation based on enterprise data collection

and a throughput level of 180 pigs per hour, pig slaughter is performed every second day for 4.5 hours per day. In the remaining time, workers perform boning, chopping and the production of casings. Based on the throughput capacity of the plant, 1440 pigs can be slaughtered in one single shift per day (8 hours per shift), which, calculating with 250 workdays per year, equals to the slaughter of 360 thousand slaughter pigs per year. As a comparison, the current level of capacity utilisation is 28%. At the same time, these types of plants should operate at least in two shifts in order to utilise their capacity as best as possible, thereby reducing their specific slaughter costs which would result in slaughtering up to 720 thousand slaughter pigs per year. As a comparison, the current level of capacity utilisation is only 14%. However, increasing the amount of processed pigs is limited by the amount of live animals that can be brought in from the vicinity of the plant, as well as the related logistics and the cooling capacity available to the enterprise. A significant proportion of the cooling capacity is currently hired. Lack of skilled and unskilled labour is another restricting factor both in the case of the examined enterprise and on a national level, while the current market position of the enterprise and the related potentially marketable amount of products also poses a limitation.

As a next step, the influence of increasing the number of processed slaughter pigs on the direct cost of slaughter and cutting was examined, assuming that the above mentioned restricting factors are eliminated. In accordance with the methodological section, the cost response rate calculated on the basis of the 2012-2016 income statements of the enterprise was 0.952, which means that 95.2% of the enterprise's total costs are variable costs and 4.8% are fixed costs (Table 3). If the cost of live animals (i.e. 80.2% of all production costs) is deducted from variable costs, the proportion of variable costs excluding live animals is 15.1%. Consequently, it can be concluded that 75.9% of costs excluding live animals is variable costs and 24.1% is fixed costs. As a next step, it was assumed that the direct production costs excluding live animals (1.9 million EUR) of the slaughter and cutting plant

are in conformity with the proportions shown at the enterprise level; therefore, the direct production cost were divided into variable costs (1.4 million EUR) and fixed costs (0.5 million EUR) (Table 4). As a result, 75.9% of the slaughter and cutting costs excluding live animals is variable costs, which means that the response rate of slaughter and cutting costs is 0.759, depending on the given output.

Table 3. The proportion of fixed and variable costs at the enterprise level

Description	Distribution (%)	Distribution excluding live animals (%)
Variable costs	95.2	-
of which: Cost of live animals	80.2	-
Further variable costs excluding live animals	15.1	75.9
Fixed costs	4.8	24.1

Source: own calculation based on enterprise data collection

Table 4. The proportion of fixed and variable costs in the plant

Description	Value (EUR)	Distribution excluding live animals(%)	Distribution (%)
Direct production cost	14 506 487	-	100.0
of which: – Cost of live animals	12 616 798	-	87.0
– Direct cost excluding cost of live animals	1 889 688	-	13.0
of which: variable costs	1 434 646	75.9	9.9
fixed costs	455 042	24.1	3.1
– Total variable costs	14 051 444	-	96.9

Source: own calculation based on enterprise data collection

The study also includes sensitivity analysis based on an expert's estimation of a ±0.1 deviation (i.e. ±10% in the proportion of variable costs) to the cost response rate calculated for slaughter and cutting costs. As a next step, it was analysed how slaughter and cutting costs change as a result of different output levels and different cost response rates (Table 5). The higher the proportion of fixed costs are, i.e. the lower the cost response rate is, the more the specific slaughter and cutting costs can be decreased, depending on the amount of processed slaughter pigs. If the number of slaughter pigs processed is increased by 20% in comparison with the current level, the specific slaughter and cutting costs can be reduced by 2.3-5.7%. If the plant performed slaughter for 4 hours each day, output would reach 180 thousand pigs and specific costs could be reduced by 6-15% to 16.0-17.7 EUR per pig. If the enterprise could utilise its yearly slaughter and cutting capacity of 360 thousand pigs in accordance with a single shift per day (8 hours per shift), the direct cost of slaughter and cutting one pig could even be between 14.2-17.0 EUR.

Based on the data obtained from the enterprise, the direct costs of slaughter and cutting of pigs were determined for 2015. However, since the largest proportion of direct costs excluding live animals is represented by labour costs, it was necessary to examine how the changes to laws for minimum wage, guaranteed living wage and employer's contributions in 2016 and 2017 (ceteris paribus) affect processing costs (Table 6). In 2016, both minimum wage and guaranteed living wage increased by 5.7%, which is estimated to have resulted in a 5.7% increase in labour costs and 1.74% increase in slaughter and cutting costs. There were even more significant changes in these terms in 2017. Despite the fact that the rate

Table 5. Slaughter and cutting costs by production and cost response levels, in EUR per pig

Slaughter and cutting costs		Number of slaughtered pigs (thousand pigs per year)							
Cost response rate		100	120	140	160	180	200	270	360
	0.659	18.90	17.82	17.06	16.48	16.03	15.68	14.84	14.25
	0.709	18.90	17.98	17.33	16.84	16.45	16.15	15.44	14.93
	0.759	18.90	18.14	17.60	17.19	16.87	16.62	16.03	15.61
	0.809	18.90	18.30	17.87	17.54	17.29	17.09	16.63	16.29
	0.859	18.90	18.45	18.14	17.90	17.71	17.57	17.22	16.98

Source: own calculation based on enterprise data collection

Table 6. Slaughter and cutting costs at various wage and contribution levels

Description	Unit	2015	2016	2017
Minimum wage	EUR/month	339	358	411
Guaranteed living wage	EUR/month	394	416	520
Employer's contributions rate	%	28.5	28.5	23.5
Wages	EUR	446 079	471 636	571 539
Employer's contributions	EUR	127 133	134 416	134 312
Labour costs	EUR	573 212	606 052	705 851
Directs costs excluding live animals	EUR	1 889 688	1 922 52	2 022 327
Directs costs excluding live animals	EUR per pig	18.90	19.23	20.22
Amount of change (2015=100%)	%	100.00	101.74	107.02

Source: own calculation based on enterprise data collection

of contributions paid by the employer decreased by 5%, the minimum wage increased by 14.9% and guaranteed living wage increased by 24.8% in comparison with 2016. These changes are estimated to have increased labour costs by 16.5% and slaughter and cutting costs by 5.2%. Altogether, the slaughter and cutting of a slaughter pig costs 7% more for the plant at the 2017 level of wages and contributions (ceteris paribus) than in 2015. In short term due to limited financial resources the enterprise couldn't perform technological development to make substitution of labour and to increase labour efficiency. Therefore, the cost-increasing effects of changes to law for minimum wage, guaranteed living wage and contributions couldn't be reduced.

CONCLUSIONS

The net outputs of product relative to live pig weight processed in the examined plant are 78.7% cold half pig share with fat, 77.2% cold half pig share without the head, 56.4% cold half pig share without fat and head, and 48.5% chopped and boned meat products. The purchase price of live pig was 113.7 EUR per 100 kg in 2015. Consequently, the stock value of raw material was 141.6 EUR per 100 kg for cold half pig share with fat, 143.7 EUR per 100 kg for cold half pig share with fat and without the head, 178.9 EUR per 100 kg for cold half pig share without fat and head and 200.6 EUR per 100 kg for chopped and boned meat products.

Based on the cost calculation results, it can be concluded that the direct production cost of slaughter and cutting, excluding the cost of live animals, was 18.9 EUR per pig in the case of processing 100 thousand pigs per year in the examined Hungarian mid-scale enterprise in 2015. Consequently, the first part of hypothesis H1, i.e. "At the plant, based on the current level of capacity utilisation, the direct cost of slaughter and cutting was between 16.1-19.4 EUR per pig in the examined period" is accepted. Labour costs represented the highest share (30%) within the cost structure, followed by used services (29%) and energy cost (21%) when the cost of live animal is excluded. Consequently, the second part of hypothesis H1 "the largest share of which was represented by labour costs" can also be accepted. This shows the significance of the change of Hungarian wage and contribution standards for the meat industry, since it has a great impact on processing costs. Based on changes to the wage and contribution standards, it was estimated that slaughter and cutting costs would be 7% higher in 2017 compared to 2015, and are attribute to significant increase in minimum wage (14.9%) and guaranteed living wage (24.8%), as well as a 5% decrease in employer's contributions in 2017. The increase in wage level and lack of labour in the processing industry call for modernisation and automatization, in conformity with the tendency shown by the European meat processing industry in the last two decades (EC, 2011).

Compared to the plant capacity of a daily single 8-hour shift (processing 360 slaughter pigs per year), the current work schedule – 4.5 hours of slaughtering every second day – results in a low level of capacity utilisation (28%). According to the calculation performed in this study, an increase of capacity utilisation could result in reducing the direct cost of slaughter and cutting to an estimated 14.2-17.0 EUR per pig in the case of processing 360 thousand slaughter pigs per year. Consequently, the first part of hypothesis H2 ("The current level of capacity utilisation is low") can be accepted, but the second part ("its improvement could potentially result in reducing the cost of slaughter and cutting to 12.9 EUR per pig") is rejected. At the same time, there are several restricting factors concerning the optimum utilisation of capacities within both the external and internal environment of the enterprise. In order to increase output and improve capacity utilisation, the enterprise primarily needs to increase the amount of live animals brought in, which can only be provided with reliable supplier relations and long-term agreements. However, the structure and tendency of the current pig product chain in Hungary – decreasing pig population, many small-scale processing plants with underutilised capacities – pose further restrains. Cooling capacity is another limitation. The extension of cooling capacity is recommended for the enterprise, if its additional cost is less than the cost savings that could be achieved by better utilisation of slaughtering and cutting capacity as well as availability of sufficient capital. Covering the increasing demand for labour in relation to extending production is also a problematic issue both for the enterprise and at a national level. In parallel with increasing output, current markets also need to be extended and new ones have to be built up. As a result, the amount of products to be produced is also fundamentally affected. It has to be added that even if this enterprise processed 360 thousand pigs per year, it would still be considered small-scale in international comparison. Although not analysed here, it is recommended for the enterprise to consider a shift to producing higher value end products and, accordingly, to invest in product development, which, again, may be restricted by existing and available financial resources.

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